STRATEGIC AND CRITICAL NONFUEL MINERALS: PROBLEMS AND POLICY ALTERNATIVES

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PREFACE

The United States' dependence on foreign nonfuel minerals has caused concern about U.S. vulnerability to a disruption of these imports. Many of the minerals are held in the National Defense Stockpile, but the stockpile is incomplete and new acquisitions have not been made for several years. The Congress is also considering reauthorization of the Defense Production Act. Title III of this act allows the President to undertake measures to promote domestic production of these minerals.

At the request of the Senate Committee on Commerce, Science, and Transportation, the Congressional Budget Office (CBO) has prepared this analysis of strategic and critical minerals. In keeping with CBO's mandate to provide objective analysis, the report makes no recommendations.

The paper was prepared within CBO's Natural Resources and Commerce Division, under the supervision of David L. Bodde and Everett M. Ehrlich. Robert J. Barbera, Emily Fox, and Mollie F. Quasebarth contributed to the various drafts. CBO wishes to thank Dr. Jacob Kaplan and Dr. Leonard Fischman for their assistance and guidance in the preparation of this report. Dr. Charles W. Berry of the Colorado School of Mines, Dr. John Morgan of the Bureau of Mines, and Dr. John J. Schanz, Jr., of the Congressional Research Service, all provided valuable services, although they are in no way responsible for the final contents. Patricia H. Johnston edited the manuscript. Kath Quattrone and Mary Pat Gaffney typed the early drafts and Deborah Dove prepared the report for publication.

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SUMMARY

The United States is a net importer of 64 "strategic and critical" minerals and metals. 1/ Varying levels of reserves are held in the National Defense Stockpile, the cornerstone of U.S. minerals policy.

U.S. import dependence is almost total for minerals such as chromium, cobalt, manganese, bauxite, and the platinum-group metals. Moreover, U.S. dependence on imported minerals is increasing, partly because of increased consumption and partly because of the declining competitiveness of U.S. mineral resources in international markets. Apart from iron and steel, the United States ran a $2 billion deficit in minerals trade in 1982. The 1970s witnessed two oil price shocks resulting from actions by the OPEC cartel and the interruption of Zairian cobalt production caused by political insurrection. These events focused attention on U.S. dependence on foreign minerals as a significant policy problem.

Dependence on foreign minerals creates risks for the U.S. economy and for national preparedness in the event of war. It raises concerns that the flow of minerals may be interrupted or that foreign mineral producers may form an OPEC-type organization to raise prices. But, while there are risks inherent in U.S. dependence on imported minerals, there are significant benefits as well. Many of these minerals are not found in the United States or could be produced here only at costs far above existing market prices. Prohibiting or limiting exports, or otherwise raising prices to levels at which U.S. production could be sustained, would severely penalize industries using the minerals--among them the automotive, steel, aircraft, and machine tool industries. Moreover, the properties of many of these minerals enhance technological advances, as in microelectronics and fiber optics.

Thus, any strategy to improve national policy for strategic and critical minerals must balance the benefits realized by their importation against the risks posed. In addition, policymakers must consider the need for these minerals in planning for defense contingencies. Thus, policymakers should

1. Strategic and critical materials are defined as those that are needed to supply the military, industrial, and civilian needs of the United States during a national defense emergency and whose supplies are dependent on imports. Strategic and Critical Materials Stockpiling Revision Act of 1979 (Public Law 96-41).

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focus on U.S. vulnerability to the risks of importing minerals rather than on simple dependence. This analysis examines U.S. vulnerability to supply disruptions of eight major minerals: aluminum, chromium, cobalt, copper, lead, manganese, platinum (and the other "platinum-group" metals), and zinc. These minerals were selected to illustrate the range of problems and circumstances surrounding minerals policy.

DETERMINANTS OF MINERALS VULNERABILITY

The dangers posed by mineral import dependence are either that their supply will be interrupted or that a mineral monopoly or cartel will manipulate prices and supplies to its advantage and at great cost to the U.S. economy. The probability of the occurrence of either event varies by mineral. The cost of such an interruption or price spike also varies by mineral, depending on its uses and the possibility of employing substitutes or conservation techniques. The risks posed by any imported mineral involve, therefore, both supply and demand factors. The supply factors include:

- The potential for a price-setting monopoly in the production or refining of the metal;
- The possibility for interruptions in the supply of the metal because of political instability or logistical difficulty;
- The potential for obtaining alternative supplies during any supply disruption; and
- The availability of stocks (such as the platinum found in jewelry or the lead in automobile batteries) that could be recycled in an emergency.

The demand factors consider how serious a disruption would be to the economy and include:

- How critical the uses of the mineral are and in which economic sectors these uses are concentrated; and
- The potential for substitutes in those uses.

The eight minerals analyzed in this report vary widely across these characteristics. Over half of the U.S. imports of chromium and platinum-group metals and about one-third of manganese come from South Africa. Although South Africa is a reliable trading partner and seems an unlikely organizer of a producers' cartel or embargo, the potential for political

instability in that nation creates the risk of a possible interruption of these metals' supplies. Cobalt raises similar concerns because of its origins in Zaire, where one major supply disruption has already occurred.

The risk posed by potential import disruptions of these four minerals is augmented by the importance of and lack of substitutes for many of their uses. For example, chromium and cobalt are essential to the production of jet engines, in which they impart strength and heat-resistance. On the other hand, both chromium and cobalt are used in a variety of applications which cannot be considered entirely strategic and for which substitutions are possible. For example, chromium is needed to produce stainless steel, but much civilian stainless steel production could be deferred in time of emergency. Cobalt's uses in magnets and paints could also be deferred or substituted for. In addition, because of these more common uses, significant amounts of cobalt and chromium can be recovered from scrap or, in the case of chromium, from recycling existing stocks of stainless steel.

Manganese is necessary in the production of all types of steel to reduce sulfur content. Because of its cheapness, there has been little effort to develop substitutes, as has occurred for chromium and cobalt. In the event of a disruption of manganese production, a variety of alternative supply sources might become available, however.

The platinum-group metals--platinum, palladium, rhodium, ruthenium, osmium, and iridium--have a variety of important applications, including the use of platinum in catalytic converters in automobile pollution-control devices. But the existence of a large stock of converters allows for significant recycling of platinum in the event of a crisis. These metals are also important in electronic applications, such as high-voltage relays. For both platinum and manganese, the capacity of refining furnaces is as important a security issue as is the availability of ore supplies.

The so-called "bulk" minerals--aluminum, copper, lead, and zinc--are widely used throughout the economy. They have more substitutes and are produced in more diverse and secure nations than the four minerals just discussed. In the cases of lead, zinc, and copper, significant U.S. resources exist, and would probably enter or reenter production if world supplies were disrupted. Moreover, these metals, together with steel, compete with other minerals in a wide variety of uses in construction, electronics, packaging, and machinery. None of them appears to pose a major vulnerability risk.

POLICY OPTIONS

The United States has a considerable range of policy options to reduce its dependence on nonfuel imported minerals and limit the impact of any

shortages that might result from such dependence. This paper examines the following policy options:

- o Increase the National Defense Stockpile;
- o Build economic stockpiles;
- o Subsidize domestic production;
- o Diversify sources of supply;
- o Encourage exploration and production on public lands;
- o Intensify metals and materials research and development; and
- o Utilize foreign policy initiatives.

In the short term, the most important options are stockpiling and domestic production. Other options are directed at long-term U.S. minerals security.

Stockpile Options

Stockpiles are named for their purposes: defense stockpiles are intended for use during a military emergency, while economic stockpiles are buffer stocks intended to smooth out transient supply disruptions (as might the Strategic Petroleum Reserve). Current minerals policy consists of a National Defense Stockpile to support military and essential civilian needs in time of war or other national emergency. It is not an economic stockpile designed to bridge markets during localized interruptions of mineral flows.

The National Defense Stockpile. About $11 billion would be needed in new appropriations to meet all of the goals set by the Federal Emergency Management Agency (FEMA) for the defense stockpile. This figure includes purchases of copper, nickel, zinc, and lead worth $3.2 billion--metals that pose a minimal vulnerability risk, given the existence of domestic reserves and nearby supplies. Moreover, the $11 billion figure is based on FEMA's estimates of the mineral demands associated with a three-year mobilization effort. If this goal was reduced to the one-year goal set by President Nixon in 1973, the sale of excess inventories of some metals could be sufficient to finance fulfilling the goals for the others. In addition, this figure is based on current market prices. It is likely to increase, along with metals prices, as the recovery progresses. One way to reduce future procurement costs would be to emphasize purchases of minerals produced in South Africa and Zaire--such as chromium, platinum, manganese, and cobalt--where the risks of disruption appear to be the greatest.

Economic Stockpiles. The National Commission on Supplies and Shortages, established by President Ford, endorsed the creation of an economic stockpile in its 1976 report. Such a stockpile would be used to supplement mineral supplies when they were disrupted for political or logistical reasons. Several other industrial nations have economic stockpiles, including Sweden, Switzerland, and Japan. This type of stockpile could be created by government purchases or by tax or credit incentives to induce private users to increase their inventories. Specifically, defense contractors could be encouraged to hold larger inventories. The advantages of private stockpiling are that private companies could tailor their inventories more appropriately to evolving requirements and would rotate them to ensure freshness. The disadvantages include the federal government's dependence on private actors for reliable information and control of inventories, and the ensuing potential for abuse.

Alternatively, the National Defense Stockpile could be used as an economic as well as defense stockpile. The defense stockpile is designed to provide the material needed for a conventional military buildup, with stockpile goals set under the assumption that all foreign mineral supplies would be cut off for three years. This stockpile, of course, would be useless in a nuclear war, and a conventional war of that duration and scope (involving a three-year cessation of all foreign trade) appears highly unlikely. The Congress might wish to consider allowing use of the defense stockpile during localized disruptions of individual minerals, just as the Strategic Petroleum Reserve was established to bridge oil import disruptions. It could build an economic stockpile by assigning priority to purchases of those minerals in greatest jeopardy, particularly those imported from southern and central Africa. These changes in stockpiling policy would require new legislation.

Subsidizing Domestic Production

Title III of the Defense Production Act of 1950 authorizes the President to guarantee loans and take other measures designed to expand production of strategic minerals in the interest of the national defense. During the Korean War, this authority resulted in sizable increases in domestic production of aluminum, copper, tungsten, and other metals. But this production was achieved at a significant cost--by 1959, subsidized production acquired by the government at a cost of $1.4 billion was worth only $0.8 billion at market prices.

The disadvantage of this option is its potential cost. In the case of cobalt, for example, a previous Congressional Budget Office report suggested that the subsidy required to induce domestic cobalt production was

conceivably larger than the market price itself. 2/ This disadvantage is minimized, however, when domestic reserves are only marginally inferior to competitive foreign ones. This is generally truer for the "bulk" minerals--such as copper, lead, and zinc--for which U.S. vulnerability is low. While assisting domestic mineral production would provide some relief to a depressed industry and its affected communities, the added costs of producing minerals from domestic resources would be imposed on other sectors of the economy.

Other Options

Other options available to the Congress could be employed to ease the nation's long-term vulnerability to minerals disruption.

Diversification. Diversifying sources of supply offers both U.S. metal-using industries and the economy as a whole greater assurance that damage from supply contingencies could be contained. Diversification would provide alternative supplies during a disruption and lower the probability of a successful cartel manipulating minerals markets. U.S. policy has traditionally encouraged U.S. investment in resource industries of developing nations, but such policy does not discriminate in favor of investments that represent true diversifications. A policy of supply diversification could be pursued either through U.S. bilateral aid or through multilateral lending facilities, such as the World Bank.

Access to Public Lands. About one-third of U.S. land area is public lands, and half of this amount is closed to minerals exploration and development. Providing access to these lands is controversial, given the inherent conflict between development and aesthetic preservation. A survey (perhaps done by the U.S. Geological Survey) of public lands resources could minimize the conflict between wilderness preservation and minerals development by better defining the mineral wealth of public lands. 3/

Research and Development. Research and development (R&D) in the area of minerals exploration, production, and materials application can and

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2. Congressional Budget Office, Cobalt: Policy Options for a Strategic Mineral (September 1982).

3. The details of such a survey can be found in Assessing the Mineral Potential of the Public Lands, Congressional Research Service Report Number 82-XXX 5(May 1983).

has limited U.S. vulnerability to shortages of imported minerals. The substitution of ceramic magnets for cobalt ones and the development of new replacements for metals (such as graphite) are examples of these innovations. Federal research funds for materials, however, are dominated by fuels and renewable resources. The Administration's proposed increase in research and development funding for fiscal year 1984 might reverse this trend. If not, the Congress might wish to consider legislation to promote R&D for minerals and metallurgical science.

Foreign Policy Initiatives. The international character of mineral flows makes mineral vulnerability a foreign policy issue. Expanding and diversifying minerals supplies might be best accomplished within the context of the international development agencies, but such a program would require U.S. leadership.

A separate foreign policy issue concerns the stability of major minerals producers, particularly South Africa. South Africa has been a reliable supplier of minerals, but its long-term stability is clouded by the issue of its racial policies. A successor regime could tamper with the stability of minerals supplies if it came to power on unfriendly terms with the United States and other Western nations. The impetus to do so, however, would be tempered by its need for foreign exchange.

In general, a review of foreign policy focused on the sources of U.S. concern about the stability of mineral supplies, could suggest diplomatic efforts that would stabilize and diversify mineral imports without significant budgetary costs. New policy initiatives could be implemented through trade agreements or other steps to assure the security of minerals supplies.

CHAPTER I. INTRODUCTION

The United States uses a fourth or more of most of the world's nonfuel minerals. Although it produces domestically a much larger proportion of its requirements than any other industrialized country, except the Soviet Union, it is nonetheless a major importer of raw and processed minerals. 1/ Apart from iron and steel, the United States ran a $2 billion deficit in minerals trade in 1982.

The term "dependence" is often used to describe the problem posed by such imports. The perception of dependence arose from the experience of two World Wars and the Korean War, during which production of essential equipment for military and civilian purposes was threatened by shortages of imported raw materials. Because of their importance in times of national emergency, these minerals came to be viewed as "strategic and critical." The most recent definition of strategic and critical materials appears in the Strategic and Critical Materials Stock Piling Revision Act of 1979 (Public Law 96-41), as follows:

> The term "strategic and critical materials" means materials that (a) would be needed to supply the military, industrial, and essential civilian needs of the United States during a national emergency, and (b) are not found or produced in the United States in sufficient quantities to meet such need.
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> The term "national emergency" means a general declaration of emergency with respect to the national defense made by the President or by the Congress.

Concerns about the national security implications of dependence on imported minerals supplies were heightened by the oil shocks of the 1970s, occasioned by the embargo by Arab producing countries and the Iranian Revolution, with their attendant rapid increases in oil prices. Expropriations of producing properties, political instability in producing countries (as affected Zaire's cobalt supplies in 1978), and proposals to tie mineral prices

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1. It is also noteworthy that the United States is an important exporter of about 20 minerals and metals--for example, molybdenum, magnesium, rare earth metals, boron, bromine, helium, scrap steel, and phosphate rock, as well as metallurgical coal.

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to industrial prices (as a part of a "New International Economic Order") reenforced fears about the reliability of Third World sources of mineral supplies.

Over the past decade, a variety of economic concerns has been added to national security considerations in assessing U.S. dependence on foreign minerals. The adequacy of new investment in developing additional mines and processing capacity has been questioned. The prospect of cartels has stirred further fears. The growth of state trading in minerals and Third World hostility to the traditional multinational mining companies has combined with the ostensible success of OPEC to suggest that governments in other developing countries might organize cartels and multiply the prices of their mineral exports. Although such attempts have had little success to date, an extended period of rapid economic growth and increased demand throughout the industrialized world could tax minerals production capacity and raise prices significantly, even in the absence of cartel actions.

THE NATURE OF THE PROBLEM: DEPENDENCE VS. VULNERABILITY

A more precise statement of the minerals supply problem would focus not on dependence but on U.S. vulnerability to a curtailment of expected supplies of minerals from foreign sources. While dependence can be defined as the percentage of U.S. consumption provided by foreign suppliers, vulnerability involves a variety of factors, including the degree of monopoly in mineral supply, the availability of recyclable stocks, the criticality of the mineral's uses, and the availability of alternatives or conservation opportunities. The circumstances that could result in a curtailment or cessation of shipments to the United States and their likelihood must also be assessed to determine vulnerability.

While risks are certainly inherent in using imported minerals to satisfy domestic needs, the benefits of doing so are also undeniable. For a number of minerals--such as chromium, columbium, or mica--U.S. supplies are either so small as to make extraction costs prohibitive or so limited that they were exhausted long ago. The United States produces another group of minerals in quantities sufficient only to meet a small fraction of U.S. demand. For both of these groups, prohibiting imports to alleviate vulnerability would impose very high costs on U.S. industry. In order to replace imported minerals, it would be necessary to undertake one or more costly alternatives: exploit uneconomical deposits within the country, resort to less satisfactory substitutes, or launch an expensive research and development effort to develop adequate substitutes.

Another group of materials is imported in raw or processed form because they can be obtained from foreign sources at somewhat lower cost

than from domestic sources. Such lower costs may be important in maintaining the competitiveness of U.S. production of the goods or equipment in which the imported metals are contained. For example, domestically produced copper could be substituted for aluminum in many uses, but only at higher cost. Similarly, production of domestic iron ore could be increased to replace imports, but the added expense would further disadvantage U.S. steel production, which is already hard pressed by foreign competition.

Thus, relying on imported supplies of materials poses both costs and benefits. The costs of such reliance consist of risks that shortages may occur as a result of military, political, or economic contingencies, or natural disasters in the country of origin. The benefits consist of lower costs for defense and industrial production, which, in turn, lower costs to U.S. consumers and make U.S. products more competitive in domestic and foreign markets. These costs and benefits can be analyzed and their magnitudes weighed. Policies to ameliorate the problems arising from dependence on foreign minerals suppliers must balance these costs and benefits.

PLAN OF THIS PAPER

This paper analyzes the vulnerability risks posed by eight major strategic minerals. Chapter II presents an overview of minerals vulnerability and the development of the National Defense Stockpile. Chapter III examines the vulnerability issue in greater detail for four strategic minerals--chromium, cobalt, manganese and the platinoid group of metals--that would be essential in a national emergency, especially for defense production. In Chapter IV, similar assessments are made for four "bulk" minerals (that is, those with important and widespread uses in the U.S. economy)--copper, lead, zinc, and aluminum. Except for aluminum, the United States has substantial reserves of these minerals. Chapter V discusses policy options to enhance minerals security.

CHAPTER II. BACKGROUND

This chapter presents an overview of U.S. dependence on foreign minerals and the nature of U.S. vulnerability to interruptions in their supply. It then discusses the evolution and the role of the National Defense Stockpile.

U.S. IMPORTS OF METALS AND MINERALS

The Bureau of Mines of the U.S. Department of the Interior evaluates annually U.S. import reliance for 85 metals and minerals. The United States is a net exporter of 19 and imports are not recorded for two more. For 12 materials, data are withheld to maintain the confidentiality of the records of the limited number of producers or users. For seven others, the available data are not sufficient to calculate net import reliance. The Bureau then provides net import data for the remaining 45 materials. For both the 12 "withheld" and seven "not available" groups, however, there is evidence that the United States imports a significant proportion of its needs.

Thus, there are 64 minerals and metals for which the United States is a net importer. The United States has no current strategic stockpile goals for 35 of the items on this list, however. 1/ Among these are gold, silver, gem stones, and a number of building materials or agricultural products for which domestic production could be expanded at relatively low additional cost or which are largely imported from Canada (such as, potash and peat). Most of the rest have important uses but adequate alternatives can be substituted; such substitutes are either produced domestically or appear elsewhere in the stockpile goals.

The United States is, therefore, consistently a net importer of 29 strategic and critical minerals that are included in the National Defense Stockpile. 2/ Table 1 lists these minerals, together with percentages

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1. The United States does have a very small stockpile goal (28 short tons) for steatite block and lump talc. It is a net exporter of talc, though dependent on foreign sources for the special form mandated by the Federal Emergency Management Agency for stockpiling.

2. The National Defense Stockpile includes 93 commodities that incorporate 34 different minerals. However, five of these minerals are not net imports, have a zero stockpile target, or are a synthetic product assembled in the United States from imported substances.